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dimethylaniline, and an organic thiol; or the photoimageable dye is selected from the group consisting of LCV, LECV, LPCV, LBCV, LV-1, LV-2 and LV-3.

Cancel Claim 10.

Please add new Claim 11

11. A process for effective photopolymerization or effective photoimaging of a composition according to Claims 1, 2, 3 or 4, wherein the composition contains at least 0.5 weight percent of the near infrared dye, to a photopolymerized or photoimaged photopolymer comprising exposing the composition to near infrared actinic radiation at a fluence of at least 100 mW/cm² (fluence units) for a period of at least 2 seconds (time units).

REMARKS

In the June 18, 2002 Office action, claims 1-10 were rejected under 35 U.S.C. §112, second paragraph, for indefiniteness on the grounds that the recitation "a near infrared dye photochemical sensitizer which is substantially free of borate anion" is indefinite because the limits of the term "substantially" are not defined. In order to more particularly define the claimed invention, this language has been deleted from the claims. To more clearly define the claimed dye compounds, the claims are amended to exclude borate anions from the class of "discrete (non intra-molecular)" anions. With this amendment there is no need to define the limits of the term "substantially". Support for this amendment will be found in the examples of the specification which define various dye compounds of Formula I as distinguished from dye compounds that include borate anions, exemplified by the structure of "DF-12124" and "GW-186". Additional support for this amendment will be found in the disclosure of the specification at page 3, lines 28-30.

Consistent with the foregoing amendments, the dye compounds containing borate anions, DF-12124 and GW-186 are cancelled from claims 5 and 7.

Further in the Office action, the examiner maintains the rejection over Showa Denko KK (JP 8-297364) on the grounds that the claims would read on compounds containing borate anion. The examiner states:

"Due to the confusion as to what is meant by "a near infrared dye photochemical sensitizer which is substantially free of borate anion" and GW-186, the examiner makes the following rejection over Showa Denko KK (JP 8-297364)".

The instant application is a continuation-in-part claiming the benefit of the July 3, 1997 filing date of U.S. Serial No. 08/888,242 which is a continuation-in-part claiming the benefit of the September 5, 1996 filing date of U.S. Serial No. 08/708,476. The Showa Denko reference does not qualify as 102(b) prior art because the November 12, 1996 publication date is less than one year prior to the earliest effective filing date of the instant application, to the

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extent that there is continuity of the relevant disclosure of the instant application as compared to the disclosures in the earlier applications. Thus, reconsideration of the examiner's position that the Showa Denko reference qualifies as 102(b) prior art is requested. However, to expedite prosecution, in the event that the examiner maintains the position that the Showa Denko reference qualifies as prior art under Section 102 of the patent statute, the foregoing amendments are appropriate.

In view of this response which amends the claims to more clearly define and distinctly point out the features of the invention which distinguish over the disclosure of the Showa Denko reference withdrawal of the prior art rejection is requested.

Applicant invites the examiner to note that dependent claims 3 and 4 specify that the substituents R⁶ on the groups D¹ and D² may only be hydrogen, methoxy or trifluoromethane. In contrast to example 8 of D1 which teaches that the phenyl ring substituents are substituted by chlorine.

The amendment submitted herewith also corrects the typographical errors in claims 3, 4 which formed the basis for the examiner's objection to these claims.

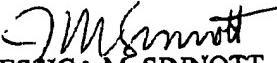
Turning to the rejection of claims 1 and 2 on the grounds that a hydrogen atom as a substituent of nitrogen in the definition of A(1) is indefinite under the second paragraph of 35 U.S.C. §112, applicant submits that the meaning of the term "nitrogen which is substituted with a hydrogen atom" is clear especially in view of the structures shown in the disclosure of the specification wherein N is bonded to a hydrogen atom and the heterocyclic ring is saturated.

Applicant has deleted the word "hydrogen" from claim 3 in response to the rejection of claim 3 on the grounds that the occurrence of the word "hydrogen" renders the claim indefinite under the second paragraph of §112. Claim 3 is further amended for clarification and consistency with the disclosure of the specification at page 33, lines 12-14. The specification at this location is also amended to correct inadvertent typographical errors.

Claim 10 is amended to recite a process to overcome the indefiniteness rejection.

Minor typographical errors in the disclosure of the specification are also corrected by this amendment.

Respectfully submitted,


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Dated: 31 Jan 2003

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In showing the changes, inserted material is underlined and deleted material is bracketed.

IN THE SPECIFICATION:

Please make changes on page 12, line 21.

Preferably, $[R_1]R_e$ and $[R_2]R_f$ are hydrogen or alkyl of 1-4 carbon atoms. Leuco dye is present in 0.1 to 5.0 percent by weight of solids in the photoimaging composition.

Please make changes on page 32, line 21.

COMPARATIVE EXAMPLES In this comparative example, a photopolymer film was made and tested in the manner as given in Examples 27-29, except that SQS, a near IR dye photosensitizer that is very effective for thermal imaging (see U.S. Patent 5,019,549), was used in equimolar levels in place of the near IR dyes tested in Examples 27-29. All other procedures were the same as previously described. Upon exposure and during the course of development, all of the photopolymer film was washed off the copper surface leaving a nearly bare or bare copper substrate with no image. This experiment indicates that the combination of SQS and a HABI photoinitiator is not capable of efficiently initiating the polymerization of monomer(s) in a photopolymer film upon exposure to near IR actinic radiation, such that both exposed and unexposed areas remain unpolymerized and are thus washed off in the course of development to afford a bare copper substrate. When used at significantly higher levels (e.g., 2.5% or more by weight) SQS is seen to initiate photopolymerization only at significantly higher intensities or power densities (megawatts/cm). As discussed elsewhere in the body of the specification, it is believed that the near IR photosensitizers of this invention work via a photochemical mechanism of energy transfer while SQS works less efficiently and only when present in higher levels via a photothermal mechanism of energy transfer.

TABLE I

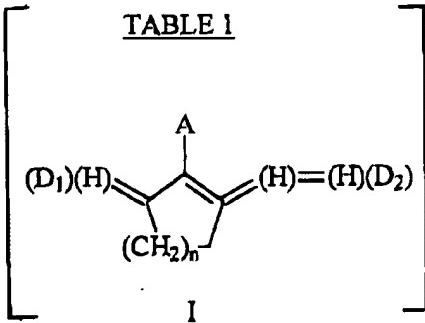
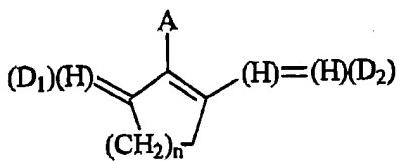


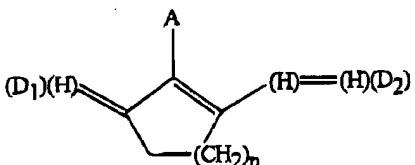
TABLE 1I

Please make changes on page 33, lines 12-14.

$R^1 - R^2 = H, C_1-C_6$ alkyl[,]; Ar, which is ["]phenyl or napthyl which is unsubstituted or substituted with halogen atom, $O(C_1-C_6$ alkyl), (C_6-C_{10}) aryl, Oaryl, or CF_3 [,]; (C_1-C_6) alkyl (C_6-C_{10}) aryl["];

IN THE CLAIMS:

1. (Amended) A near infrared sensitive composition, comprising:
 - (a) a near infrared dye photochemical sensitizer [which is substantially free of borate anion] that enables the composition to undergo either
 - (i) effective photopolymerization or
 - (ii) effective photoimaging upon exposure to near infrared radiation,
 the near infrared dye is a compound of formula I:

I

wherein substituent A is chosen from

- (1) a 5-6 membered heterocyclic ring system having 1-3 ring heteroatoms, in which the heteroatom is a nitrogen atom, which is substituted with a hydrogen atom, C_1-C_6 alkyl, $(CH_2)_mCO_2H$ or $(CH_2)_mCO_2(C_1-C_6$ alkyl) and the carbon atom of the heterocyclic ring system may be substituted with an oxygen atom to form a carbonyl or enolate anion and m is an integer ranging from 0-4;

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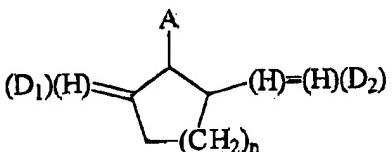
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- (2) a 5-6 membered carbocyclic moiety substituted with a hydrogen atom or a C₁-C₆ alkyl group wherein a carbon atom of the alkyl group may be substituted with oxygen to form a carbonyl or enolate anion;
- (3) a quinoline or isoquinoline group wherein the nitrogen atom is directly bonded to the carbocyclic moiety of formula I;
- (4) N,N-bisaryl or bis(C₁-C₆ alkyl) or bisaryl(C₁-C₆ alkyl) amine wherein the aryl group is a naphthyl or phenyl group which is unsubstituted or substituted with a fluorine atom, bromine atom, chlorine atom, OCH₃, CF₃, OH, or C₁-C₆ alkyl;
- (5) a heterocyclic ring system having at least one nitrogen atom bonded directly to the carbocyclic ring of formula I and a group Z which is a carbon atom, NR⁸, oxygen atom or sulfur atom wherein R⁸ is a hydrogen atom, C₁-C₆ alkyl, CO₂H or CO₂C₁-C₆ alkyl;
substituent D₁ is a 9-15 membered heterocyclic system comprising a heteroaryl ring system having at least one heteroatom group (U) which is an NR³ group, oxygen atom, sulfur atom or PR³ group which is directly bonded to the aryl portion of the heteroaryl ring system and wherein R³ is a C₁-C₆ alkyl which may be unsubstituted or substituted with CO₂H, SO₃H or salts thereof and wherein the aryl ring may be unsubstituted or substituted with OCH₃, CF₃, bromine atom, chlorine atom, fluorine atom, C₁-C₆ alkyl or OH or a fused ring polycyclic heterocyclic system;
substituent D₂ has the identical heterocyclic system as substituent D₁ except that when U is NR³, the nitrogen atom is quaternized to form an amine salt which is neutralized by an enolate anion from A when A is a substituted pyrimidine like moiety or by a discrete (non intra-molecular) anion, provided that the discrete (non intra-molecular) anion is not a borate anion;
n is an integer ranging from 1-2;
- (b) a hexaarylbiiimidazole compound as photoinitiator;
- (c) a photopolymerizable material and a chain transfer agent, or, instead of (c),
- (d) a photoimageable dye.
2. (Amended) A photopolymerizable element comprising:

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- (a) a support,
- (b) a photopolymerizable composition comprising
 - (i) a near infrared dye photochemical sensitizer [which is substantially free of borate anion] that enables the photopolymerizable composition to undergo effective photopolymerization upon exposure to near infrared radiation, the near infrared dye is a compound of formula I:



I

wherein A is:

- (1) a 5-6 membered heterocyclic ring system having 1-3 ring heteroatoms, in which the heteroatom is a nitrogen atom which is substituted with a hydrogen atom, C_1-C_6 alkyl, $(CH_2)_mCO_2H$ or $(CH_2)_mCO_2(C_1-C_6$ alkyl) and the carbon atom of the heterocyclic ring system may be substituted with an oxygen atom to form a carbonyl or enolate anion and m is 0-4;
 - (2) a 5-6 membered carbocyclic moiety substituted with hydrogen atom, C_1-C_6 alkyl group wherein the carbon atom of the alkyl group may be substituted with oxygen to form a carbonyl or enolate anion;
 - (3) quinoline or isoquinoline groups wherein the nitrogen atom is directly bonded to the carbocyclic moiety of formula I;
 - (4) N,N -bisaryl or bis(C_1-C_6 alkyl) or bisaryl(C_1-C_6 alkyl) amine wherein the aryl group is a napthyl or phenyl group which is unsubstituted or substituted with fluorine atom, bromine atom, chlorine atom, OCH_3 , CF_3 , OH , C_1-C_6 alkyl;
 - (5) a heterocyclic ring system having at least one nitrogen atom bonded directly to the carbocyclic ring of formula I and a group Z which is a carbon atom, NR^8 , oxygen atom, or sulfur atom wherein R^8 is a hydrogen atom, C_1-C_6 alkyl, CO_2H or $CO_2C_1-C_6$ alkyl;
- substituent D_1 is a 9-15 membered heterocyclic system comprising a heteroaryl ring having at least one heteroatom group (U) which is an NR^3 group, oxygen atom, sulfur atom, or PR^3 group which is directly bonded to the aryl portion of the heteroaryl ring system and wherein R^3 is a C_1-C_6 alkyl which may be unsubstituted or substituted with CO_2H , SO_3H

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or salts thereof and wherein the aryl ring may be unsubstituted or substituted with OCH₃, CF₃, bromine atom, chlorine atom, fluorine atom, C₁-C₆ alkyl or OH or a fused ring polycyclic heterocyclic system;

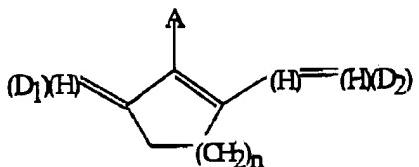
substituent D₂ has the identical heterocyclic system as substituent D₁ except that when U is NR₃, the nitrogen atom is quaternized to form an amine salt which is neutralized by an enolate anion from A when A is a substituted pyrimidine like moiety or by a discrete (non intra-molecular) anion, provided that the discrete (non intra-molecular) anion is not a borate anion:

n is an integer ranging from 1-2;

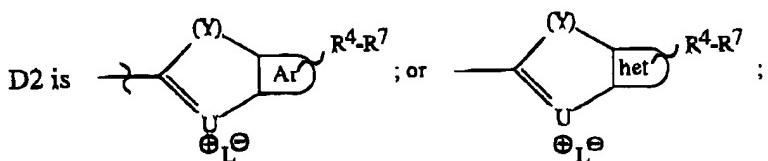
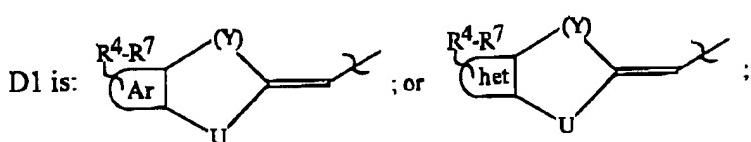
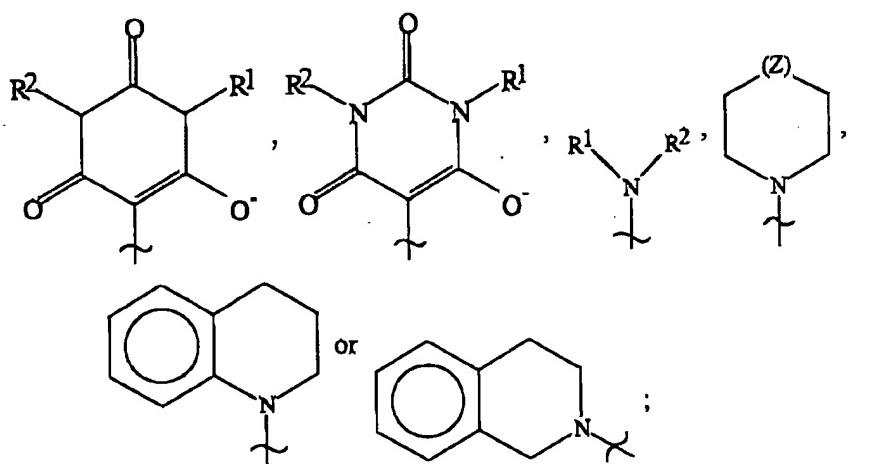
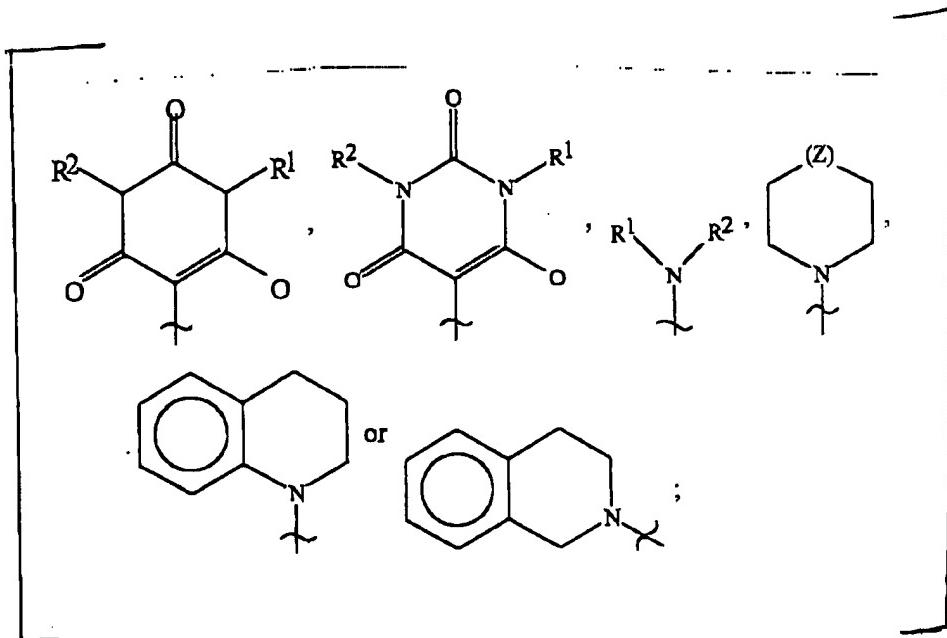
- (c) a hexaarylbiimidazole compound as photoinitiator;
- (d) a photopolymerizable material and a chain transfer agent; and
- (e) a binder polymer.

3. (Amended) A near infrared sensitive composition, comprising:

- (a) a near infrared dye photochemical sensitizer [which is substantially free of borate anion] that enables the composition to undergo either
 - (i) effective photopolymerization or
 - (ii) effective photoimaging upon exposure to near infrared radiation,the near infrared dye is a compound of formula I:



wherein substituent A is



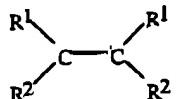
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R^1 or R^2 are independently selected from H, C_1-C_6 alkyl; or
 aryl wherein aryl is phenyl or naphthyl which may be unsubstituted or substituted
 with halogen, $-O(C_1-C_6$ alkyl), $-O$ aryl, aryl or CF_3 ;
 $[(C_1-C_6$ alkyl) ($C_{16}-C_{10}$ aryl)] (C_1-C_6 alkyl) (C_5-C_{10} aryl) [or hydrogen];

\boxed{Ar} is an aromatic ring chosen from phenyl or naphthyl;

\boxed{het} is a heteroaryl ring chosen from benzopyrazine, benzo-1,4-oxazine
 or benzo-1,4-thiazine.
 U is selected from NR^3 , S, PR^3 or O;
 Y is selected from $C(R^1)(R^2)$;



or U , wherein R^1 and R^2 are as defined above;

R^3 is selected from C_1-C_6 alkyl unsubstituted or substituted with CO_2H , SO_3H or
 salts thereof;

R^4-R^7 are independently chosen from H, OCH_3 , CF_3 , halogen;

Z is chosen from NR^8 , C, O or S;

R^8 is chosen from H, C_1-C_6 alkyl, $(CH_2)_mCO_2H$ or $(CH_2)_mCO_2(C_1-C_6$ alkyl);
 and

m is 0-6;

n is 1-2;

provided that when A contains an enolate anion, a counterion L^\ominus is not present;

(b) a hexaarylbisimidazole compound as photoinitiator;

(c) a photopolymerizable material and a chain transfer agent; or, instead of (c),

(d) a photoimageable dye.

4. (Amended) A photopolymerizable element comprising:

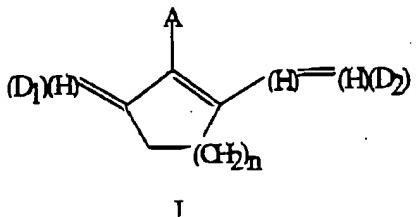
(a) a support;

(b) a photopolymerizable composition comprising

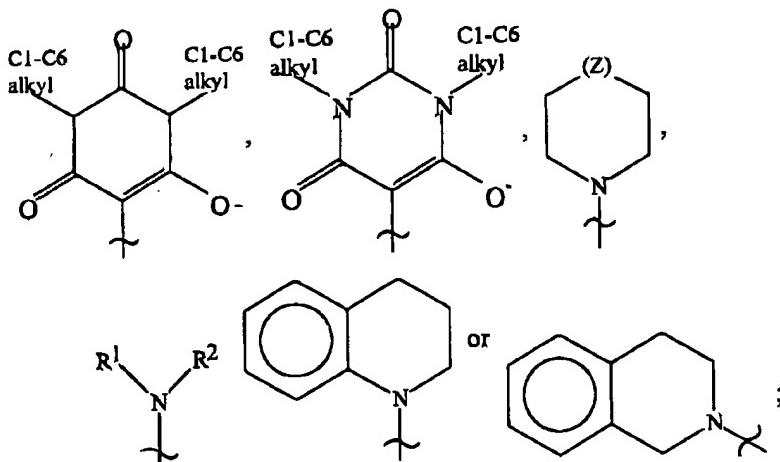
(i) a near infrared dye photochemical sensitizer [which is
 substantially free of borate anion] that enables the
 photopolymerizable composition to undergo effective
 photopolymerization upon exposure to neared infrared radiation,
 the near infrared dye is a compound of formula I:

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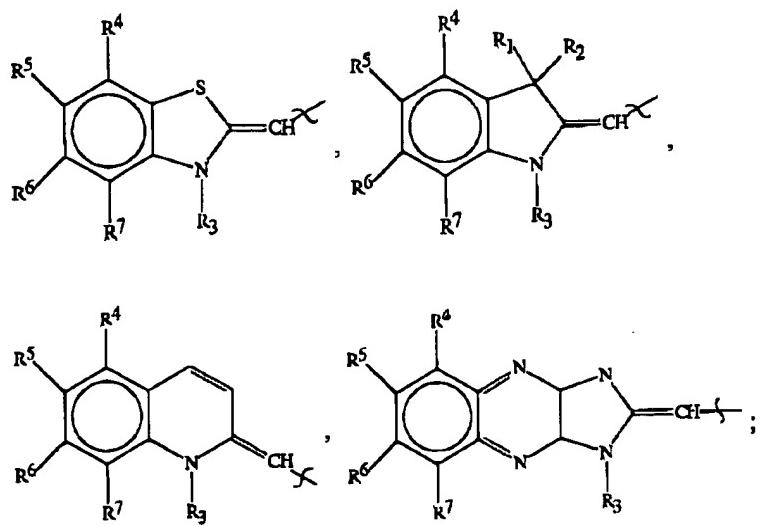
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wherein A is



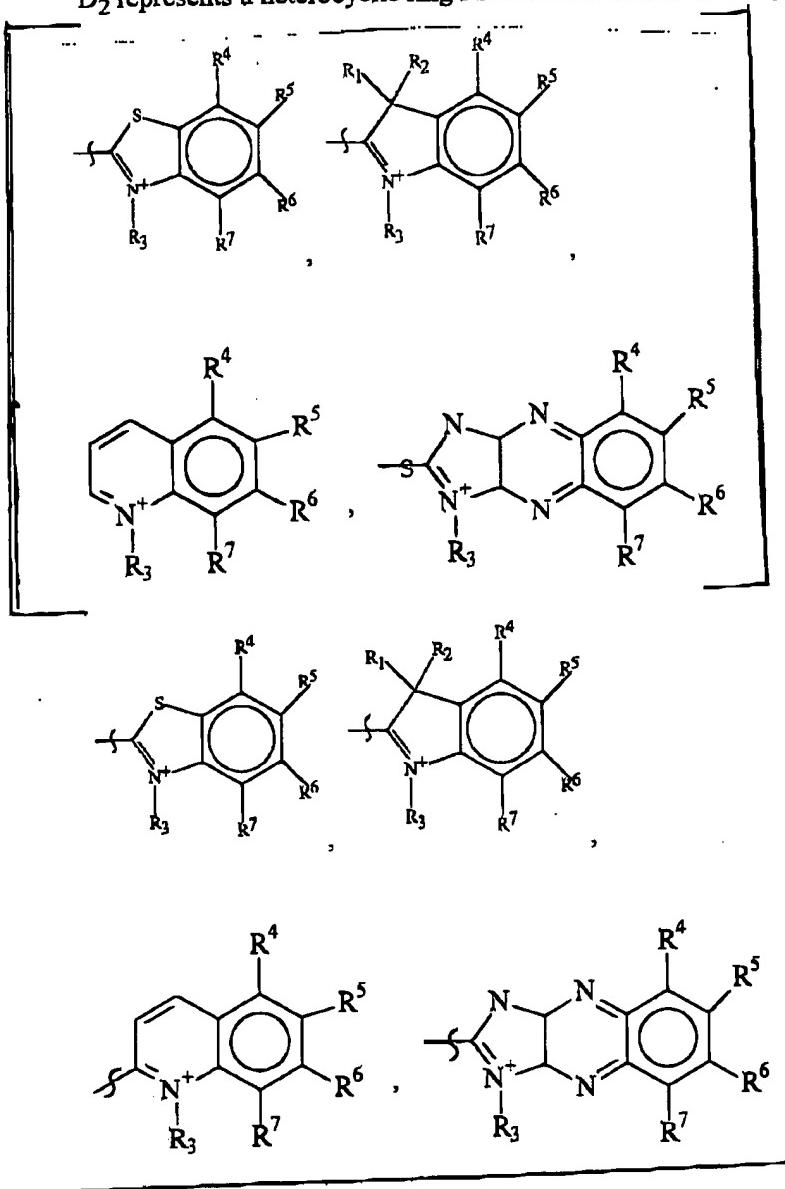
D₁ represents a heterocyclic ring structure selected from the group consisting of:



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D_2 represents a heterocyclic ring structure selected from the group consisting of



R^1 or R^2 are independently selected from:

C_1-C_6 alkyl, aryl wherein aryl is phenyl or naphthyl which may be unsubstituted or substituted with halogen, $-O(C_1-C_6$ alkyl), Oaryl, aryl or CF_3 , $(C_1-C_6$ alkyl) aryl or hydrogen;

R_3 is C_1-C_6 alkyl, C_1-C_6 alkylsulfonate, C_1-C_6 alkyloxycarbonyl, C_1-C_6 alkyl, or

C_1-C_6 alkylcarboxy;

Z is selected from NR^8 , C, O or S wherein R^8 is H, C_1-C_6 alkyl, CO_2H or $CO_2(C_1-C_6$ alkyl);

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R^4-R^7 are independently selected from H, OCH_3 , CF_3 ; or any two of R^4-R^7 which when ortho substituents may join to form a phenyl ring; n is an integer ranging from 1-2 with the proviso that D_2 is selected to be the quaternized heterocyclic ring structure that corresponds to D_1 such that D_1 and D_2 together form a pair of heterocyclic ring structures;

- (c) a hexaarylbiiimidazole compound as photoinitiator;
- (d) a photopolymerizable material and a chain transfer agent; and
- (e) a binder polymer.

5. (Amended) A near infrared sensitive composition, comprising:

(a) a near infrared dye photochemical sensitizer [which is substantially free of borate anion] that enables the composition to undergo either

- (i) effective photopolymerization or
- (ii) effective photoimaging upon exposure

to near infrared radiation wherein the near infrared dye is selected from the group consisting of DF-1413, DF-1419, DF-1422, DF-1429, DF-1668, [DF-12124,] DF-15118, DF-15131, DF-15132, NK-3877, GW-826, GW-436, GW-776, [GW-186,] and NK-2268;

(b) a hexaarylbiiimidazole compound selected from the group consisting of o-Cl-HABI, CDM-HABI, 2,3,5-TCl-HABI, and TCTM-HABI; and

(c) a photopolymerizable material selected from the group consisting of tripropylene glycol diacrylate, trimethylolpropane triacrylate, ethoxylated trimethylolpropane triacrylate, propoxylated trimethylolpropane triacrylate, ethoxylated Bisphenol A dimethacrylate, and triethylene glycol dimethacrylate, and a chain transfer agent selected from the group consisting of N-phenylglycine, julolidine, 2-mercaptopbenzoxazole, 2,6-diisopropyl-N,N-dimethylaniline, a borate salt and an organic thiol.

7. (Amended) The composition according to Claim 3, wherein the near infrared dye is selected from the group consisting of DF-1413, DF-1419, DF-1422, DF-1429, DF-1668, [DF-12124,] DF-15118, DF-15131, DF-15132, NK-3877, GW-826, GW-436, GW-776, [GW-186,] and NK-2268; the hexaarylbiiimidazole compound is selected from the group consisting of o-Cl-HABI, CDM-HABI, 2,3,5-TCl-HABI, and TCTM-HABI; wherein the photopolymerizable material is selected from the group consisting of tripropylene glycol diacrylate, trimethylolpropane triacrylate, ethoxylated trimethylolpropane triacrylate, propoxylated trimethylolpropane triacrylate, ethoxylated Bisphenol A dimethacrylate, and triethylene glycol dimethacrylate, and the chain transfer agent is selected from the group consisting of N-phenylglycine, julolidine, 2-mercaptopbenzoxazole, 2,6-diisopropyl-N,N-

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dimethylaniline, and an organic thiol; or the photoimageable dye is selected from the group consisting of LCV, LECV, LPCV, LBCV, LV-1, LV-2 and LV-3.

Cancel Claim 10.

Please add new Claim 11

11. A process for effective photopolymerization or effective photoimaging of a composition according to Claims 1, 2, 3 or 4, wherein the composition contains at least 0.5 weight percent of the near infrared dye, to a photopolymerized or photoimaged photopolymer comprising exposing the composition to near infrared actinic radiation at a fluence of at least 100 mW/cm² (fluence units) for a period of at least 2 seconds (time units).